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TWO-STEP SODA PULPING PROCESS OF RICE STRAW FOR THE RECYCLE PAPERMAKING

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Abstract

The demand of papers is increasing with the population increase. This will definitely increase the need of wood fibers as the main raw material. However, due to the wood shortages, there have been many attempts to use non-wood fibers as substitutes for papermaking. Rice straw is abundantly produced in Indonesia as one of byproducts of rice milling. In this experiment, delignified rice straw was mixed with used paper in order to make recycle papers with acceptable properties. Two-step soda pulping process of rice straw was carried out to remove out lignin. First delignification was conducted using 7% NaOH at 70^oC for 1 hour. NaOH concentrations (4%, 6%, 8%) and temperatures (40-80^oC) were varied during the second pulping process. The tensile strength of resulting pulp was increased with the increase of NaOH concentration and temperature until the optimum condition and then decreased. The optimum condition was achieved at the NaOH concentration of 6% and temperature of 50^oC. Tensile strength, water uptake and kappa number obtained on this optimum condition were 4.641 N/mm^2; 0.0184 g/cm^2; and 10.02, respectively. Two-step soda pulping process improved the quality of recycle paper in terms of mechanical properties, water resistance.

Keywords*: soda pulping, tensile strength, water uptake, kappa number*

1 INTRODUCTION

The apparent consumption of paper shows increasing amount though increase of paperless due to growing use of computers. This has consequently increased the utilisation of wood as the main raw material of papers. Non-wood fibers have been investigated to be used as enviromentally-benign alternatives to the use of trees due to its abundance as the sole effective source of cellulose fiber and cost-effectiveness. Non wood fibers derived from fiber crops (kenaf, industrial hemp, sisal, rye grass) as well as agricultural residues (wheat straw, rice straw, corn stalks, bagasse, flax straw)[1,2)] could be basically used for papermaking pulp.

In Indonesia, a total area of about 13,8 million ha[3)] was cropped with rice. The large amount of rice straw disposal as one of byproducts of paddy milling poses serious problems to the farmers and environment. Traditionally, straw has been burnt on site, which generates heavy smoke frequently resulting in breathing, cardiorespiratory and allergic problems in nearby populations. This also increases the release of large amounts of carbon dioxide to the environment contributing to the enhanced green house effect. Rice straw used for papermaking is previously delignified upon soda pulping process to decrease the lignin content. The lignin content of about 21.9%[4)] in rice straw is decreased during the pulping process. The soda process has been known to be the oldest and simplest pulping process. It is also applicable to leafy and conifer wood, as well as to non-wood raw materials such as agricultural residues[4)].

Moreover, waste minimisation, reuse, and material recycling have received increased attention over the last decade due to the national, international regulations and legislations governing waste management[5)]. Waste paper as secondary fiber resources has an important role to meet the demand of cellulose industries. Waste paper consumption is increasing by year by recycling of waste paper for papermaking. This fact has a positive impact of preserving virgin natural fiber to a great extent. The recycling process of the conventional office paper reduces the abundance of waste paper. They could be converted back into pulp prior to cleaning and re-forming.

In this experiment, rice straw was delignified with different NaOH concentrations at different temperatures during soda pulping prior to mixing with office waste papers in order to obtain recycle papers with desirable properties. The soda pulping processes were carried out in two-stages. First stage was aimed to produce pulp in a large scale followed by the optimisation process during the second soda pulping process in a batch scale. This investigation showed the potential of using the agricultural waste of rice straw and the office waste papers for the recycle papermaking.